N° 10,617 A.D. 1893

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PROVISIONAL SPECIFICATION.

Improvements in Apparatus for Calculating Photographic Exposures.

I, GEORGE FREDERICK WYNNE, of Minera near Wrexham, in the County of Denbigh in the Principality of Wales, do hereby declare the nature of this invention to be as follows :—

This invention relates to an improved apparatus for calculating photographic exposures of that class in which the light is first tested by an actinometer in the usual manner and the photographic exposure deduced therefrom.

The duration of exposure required for a photographic plate is affected by four conditions, namely—

1. The actinic value of the light,
2. The character of the subject,
3. The ratio of the diaphragm of the lens to its focal length, and
4. The sensitiveness of the plate used.

In other forms of calculating instruments hitherto used, these four factors have been calculated for separately, and a specially divided circular slide rule has been provided for each factor, and, when the resulting exposure has been shown by the instrument, it has only given the one exposure for the particular assumed values of the factors.

My improved calculating instrument is preferably made in two forms—

In one it consists of a cylindrical box, the lid of which is made so that it can be turned round upon the body of the box by means of a milled edge or other suitable device.

The periphery of the box and lid are divided geometrically, preferably into 2 scales, namely a scale of the diaphragm Nos. of plates employed (as hereafter explained) which are ascertained from actual test, and a scale graduated in the same ratio of the exposures in seconds. The circular box also serves as an actinometer for measuring the actinic value of the rays of light by noting the time which a strip of sensitive paper contained therein takes to darken to a standard tint.

In the second form, it comprises a flat slide rule, having an actinometer secured on the back thereof. This latter is formed preferably of a circular box, having a rotatable lid with an opening of suitable shape, provided with a disc of standard tint. The box is furnished with discs of sensitized paper, and these discs are prevented from rotating in the box (when the lid is turned) by being provided with lips engaging in slots in the box, the lid being rotated to expose fresh surfaces to the actinic rays of light. As the actinometer for this arrangement has not to carry any scales, it is designed in this form and is much more compact than the box arrangement before described in which a slip of sensitive paper is pulled through a slot in the usual way. The slide rule aforesaid is divided geometrically into 2 scales similar to the scales before described upon the circular instrument; the scales of the diaphragm Nos. of the plates being upon the rule and the scale of exposures in seconds being upon the brass slide (or *vice versa*) enables the computation to be made mechanically.

The speed of the plate, instead of being expressed by an arbitrary number, may be expressed by the size of diaphragm through which a plate of that particular speed would require the actinometer time for its correct exposure upon a normal subject. The more rapid the speed of the plate, the smaller would be the size of its corresponding diaphragm and *vice versa*.

The unit of plate speed or speed No. 1 is calculated as the speed which takes

(for a normal subject) the same time for exposure of a photographic plate of this rapidity through a standard diaphragm the diameter of which is equal to the focal length of the lens divided by four that the sensitive paper in the actinometer takes to colour to a standard tint.

It therefore follows that the comparative speeds of any plates of different diaphragm Nos. are represented by the uniform standard Nos. (of the Photographic Society of Great Britain) which correspond with the F Nos. of the plates compared.

The unit might obviously be calculated with reference to any other diaphragm, but $\frac{F}{4}$ is preferred, as it is usually the largest stop employed in general photography and is also the unit of the uniform standard Nos. of the above named Society for the comparative areas and duration of exposure of all other stops. It follows from this that the figure which represents the speed of the plate also represents the ratio of plate exposure to actinometer exposure for this standard diaphragm called $\frac{F}{4}$. It is obvious that the uniform standard Nos. might be engraved upon the scales against the corresponding diaphragm Nos. in order to show the actual relative speeds of the plates, but, as doing so would not in any way affect the resulting calculation and would make the instrument more complicated, it is preferred to use only the F or diaphragm Nos.

The diaphragms on the scale of diaphragms are graduated from the largest to the smallest in exactly the same proportion as the seconds scale, and in such a manner that, when the instrument is set correctly for one diaphragm, it is at the same time set correctly for all diaphragms from the largest to the smallest.

To calculate an exposure therefore for a normal subject, it is only necessary to set the actinometer time on exposure scale against the diaphragm number of the particular plate used, when against each diaphragm will be found on the same scale the correct exposure for that particular stop.

For exceptional subjects which require a longer or shorter exposure than the normal, instead of having a separate scale for calculating the variation from the normal exposure due to the subject, it is only necessary to move the slide a certain number of divisions higher or lower than the normal position according to the amount of variation required, and calculate as at this higher or lower figure.

It will thus be seen that, by the particular construction of the instrument and arrangement of scales, this one scale of diaphragms represents in itself three factors of exposure, namely, the sizes of diaphragms, the speed of the plate and the variation of exposure due to special subjects, and that the exposure scale also represents both the actinometer time and also the exposure in seconds.

Instead of the scales being divided upon the periphery of a box and lid and upon a rule and slide as described, they might obviously be divided upon two movable concentric rings or discs.

Among the advantages of my apparatus are the following—

a. The special scale or column of diaphragm numbers being progressively arranged, the one scale represents three factors of exposure, namely, the sizes of diaphragms, the speed of the plate, and the variations of exposure due to special subjects.

b. The special scale or column of seconds and fractions of seconds being also progressively arranged, the one scale represents two factors, namely, the exposure in seconds and the actinometer time in seconds.

c. The special division and combination of the scales in such a manner that, in whatever position the slide is set, the corresponding exposure is shown simultaneously against each diaphragm from the largest to the smallest.

Dated this 29th day of May 1893.

WM. P. THOMPSON & Co.,
Of 6, Lord Street, Liverpool, Patent Agents for the Applicant.

COMPLETE SPECIFICATION.

Improvements in Apparatus for Calculating Photographic Exposures.

I, GEORGE FREDERICK WYNNE of Minera near Wrexham in the County of Denbigh in the Principality of Wales, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement :—

This invention relates to an improved apparatus for calculating photographic exposures of that class in which the light is first tested by an actinometer in the usual manner and the photographic exposure deduced therefrom.

The duration of exposure required for a photographic plate is affected by four conditions, namely—

1. The actinic value of the light,
2. The character of the subject,
3. The ratio of the diaphragm of the lens to its focal length, and
4. The sensitiveness of the plate used.

In other forms of calculating instruments hitherto used, these four factors have been calculated for separately, and a specially divided circular slide rule (with pointers or with a combination of stops and pointers) has been provided for each factor, and, when the resulting exposure has been shown by the instrument, it has only given the one exposure for the particular assumed values of the factors.

My improved calculating instrument is preferably made in two forms—set forth in the accompanying drawings, Figures 1, 2 and 3 respectively.

Figure 1 shows plans of my apparatus arranged in a cylindrical box or watch case form ;

Figure 2, section of same ;

Figure 2^A^ plan of disc ;

Figures 3 and 4, two slightly varying forms of the slide rule form.

In Figure 1, the lid or glass F upon which the diaphragms and plate speed numbers scale G is printed is made so that it can be turned round upon the body of the box J by means of a milled edge *j* or other suitable device. The periphery of the box and lid or the part near the edge of the glass and the outer edge of the exposed portion of the body of the box, as shown in Figure 1, are each divided geometrically into two scales, as shown, namely, a scale G of diaphragm numbers of plates employed (as hereafter explained) which are ascertained from actual test, and a scale H graduated in the same ratio of the exposures in seconds. Either of these can be on the glass F or lid, the other of them being on the box J. The circular box also serves as an actinometer for measuring the actinic value of the rays of light by noting the time which a strip or portion of a disc of sensitive paper C contained therein takes to darken to a standard tint of disc or part *a*.

In the second form set forth in Figure 4, it comprises a flat slide rule, having an actinometer secured on the back thereof. This actinometer is only shown in outline, as it is fully set forth in Figures 1 and 2 ; it is formed of a circular box D having a rotatable upper part or lid J with an opening A (Figures 1 and 2) provided with a disc or one or more strips of standard tint of any suitable shape and size *a* and leaving exposed a part B through which a small segment of the rotatable disc of sensitised paper C, hereinafter described, can be seen.

The box is furnished with spare discs E of sensitised paper, and these discs can be prevented from rotating in the box (when the lid is turned) by being provided with lips I engaging in slots in the box or otherwise, the upper part of the box being rotated to expose fresh surfaces to the actinic rays of light. Instead, however, of these lips or slots, I may use any other suitable device for fulfilling the same object ; for instance, by fixing the disc to the box by a suitable cement, or by

placing it in contact with such a surface attached to the box that the friction of this surface acting upon the disc is sufficient to turn it, or in any other suitable way.

The disc of sensitive paper may be kept pressed up to the opening in the lid by any suitable device, but I preferably employ a disc of thick felt D^1, which possesses a considerable amount of elasticity and exerts sufficient friction to turn the disc of sensitive paper, especially if lips or projections I are formed upon it as before described.

In the drawing, C is the disc of sensitive paper; D^1, the felt pad; and E, a series of spare discs to be used in succession in place of C; L, a pin holding the pad from turning; K, a plate enclosing between it and box D a space for spare discs; M, milled edge to box D. The slide rule, Figure 3, is divided geometrically into 2 scales similar to the scales before described upon the circular instrument; the scales of the diaphragm Nos. of the plates being upon the rule and the scale of exposures in seconds being upon the brass slide (or *vice versa*) enables the computation to be made mechanically.

In the modification of this arrangement shown in Figure 4, a third scale of the relative or comparative speeds of the plates as hereafter explained is shown, but the presence or absence of this scale does not affect the working of the meter, and, although I have sold a large number with it, I intend in future to omit it as a rule.

The speed of the plate, instead of being expressed by an arbitrary number, may be, and is in the drawings, expressed by the size of diaphragm through which a plate of that particular speed would require the actinometer time for its correct exposure upon a normal subject. The more rapid the speed of the plate, the smaller would be the size of its corresponding diaphragm, and *vice versa*.

Where the scale of relative or comparative speeds is used, the unit of plate speed or speed No. 1 may be calculated as the speed which takes (for a normal subject) the same time for exposure of a photographic plate of this rapidity through a standark diaphragm (the diameter of which is equal to the focal length of the lens divided by four) that the sensitive paper in the actinometer takes to colour to a standard tint.

It therefore follows that the comparative speeds of any plates of different diaphragm Nos. are represented by the uniform standard Nos. (of the Photographic Society of Great Britain) which correspond with the F Nos. of the plates compared.

The unit might obviously be calculated with reference to any other diaphragm, and, if the unit is taken with reference to F 45, then, when the scales of the instrument are placed in their normal position as shown, the comparative or relative speed of any plate will be simultaneously found against its diaphragm No.; thus F 45 = 1 — F 64 = 2 — F 90 = 4 — F 28 = $\frac{1}{8}$ — F 8 = $\frac{1}{32}$ and so on.

If F 4 is taken as the unit for the comparative speeds of the plates, the figure which represents the speed of the plate will also represent the ratio of plate exposure to actinometer exposure for this standard diaphragm called $\frac{F}{4}$. It is obvious that the uniform standard Nos. or any other comparative Nos. might be engraved upon the scales against the corresponding diaphragm Nos. (as shown in one plan of the slide rule form of instrument) in order to show the actual relative speeds of the plates, but, as doing so would not in any way affect the resulting calculation and would make the instrument more complicated, it is preferred to use only the F or diaphragm Nos.

The diaphragms on the scale of diaphragms are graduated from the largest to the smallest in exactly the same proportion as the time scale, and in such a manner that, when the instrument is set correctly for one diaphragm, it is at the same time set correctly for all diaphragms from the largest to the smallest.

To calculate an exposure, therefore, for a normal subject, it is only necessary to set the actinometer time on exposure scale against the diaphragm number of the

particular plate used, when against each diaphragm will be found on the same scale the correct exposure for that particular stop.

For exceptional subjects which require a longer or shorter exposure than the normal, instead of having a separate scale as hitherto employed for calculating the variation from the normal exposure due to the subject, it is only necessary to move the slide a certain number of divisions higher or lower than the normal position according to the amount of variation required, and calculate as at this higher or lower figure.

It will thus be seen that, by the particular construction of the instrument and arrangement of scales, this one scale of diaphragms represents in itself three factors of exposure, namely, the sizes of diaphragms, the speed of the plate and the variation of exposure due to special subjects, and that the exposure scale also represents both the actinometer time and also the exposure in seconds.

It will be seen that the scales can be divided either upon the periphery of a box and lid, upon two movable concentric rings or discs, or upon a rule and slide.

Describing further Figure 2, F is the glass to which is securely cemented the diaphragm number scale as shown; J, upper part of body; D, lower part of body having milled edge for turning the same or for holding it while the top is turned. It will thus be seen that, by moving the glass relatively to the upper part of the body, the scales are adjusted to each other, while, by moving the lower part round slightly, a fresh piece of the sensitised paper disc is exposed.

It is obvious that, instead of having one of the scales fixed to the glass, it might be fixed to an extra and specially made part of the case, but the plan shown being the simplest is the one I prefer to employ.

The mode of working is as follows:—

Instead of expressing the sensitiveness of a plate by an arbitrary number, it is expressed by the size of diaphragm through which the plate would require the actinometer time for its correct exposure upon a normal subject. Thus Ilford ordinary plates, No. F 39, means that an ordinary subject upon these plates, through stop F 39, would require the actinometer time for its correct exposure.

To Calculate the Correct Exposure.

Turn the movable scale of the instrument until the actinometer time in seconds upon the exposure scale is opposite the diaphragm number of the plate. Then the correct exposure in seconds and fractions of seconds will be found simultaneously against each stop from the largest to the smallest.

Example No. 1:—

Plate No.	F 45.
Actinometer	12 seconds.
Stop	F 16.

Put 12 seconds against F 45. Then against F 16 will be found 1½ seconds, which is the correct exposure, and also against every other stop, the correct exposure for that particular diaphragm.

Example No. 2:—

Plate No.	F 90.
Actinometer	3 seconds.
Stop	F 5·6.

Put 3 seconds against F 90. Then against F 5·6 will be found $\frac{1}{85}$ of a second, and also against every other stop, the correct relative exposure. If, in an interior exposure or an exposure in a shaded situation, the sensitive paper takes minutes instead of seconds to colour to the standard tint, the figures upon the exposure scale may be read as minutes instead of seconds.

Photographing Exceptional Subjects.

For panoramic views or open landscape with no dark objects in the foreground, instead of setting the actinometer time against the actual plate speed number, set it two speeds higher than this, and calculate as if the plate speed were this higher figure. Thus, with plate speed F 45, set actinometer time to F 64; or with plate speed F 78, set it to F 111.

For sea and sky, set the actinometer time six speeds higher than the actual plate speed used, and calculate as if plate speed were this higher figure. Thus, with plate speed F 45, set it to F 128, or with plate speed F 90, set it to F 256. If preferred, the exposure for sea and sky may be found by calculating as for an ordinary exposure, and dividing by from 8 to 10.

Simplicity of Instrument.

It will be seen from the foregoing description that the simplicity of the instrument is not attained by ignoring any of the factors of exposure, but by the scales being so designed that each of them represents in itself two or three of those factors.

Thus: The scale of diaphragms represents—

Firstly, the scale of diaphragms:
Secondly, the speed of plate: and
Thirdly, the variation of exposure due to subject; while the time scale represents the actinometer time and also the exposure in seconds or minutes.

The scales are also so divided and arranged that, when they are set correctly for one diaphragm, they are simultaneously set correctly for every diaphragm from the largest to the smallest.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. The arrangement of an exposure meter in which the exposure required is calculated with only two scales, one being the scale of diaphragm numbers and the other the scale of time, substantially as described.
2. In an exposure meter, a scale of diaphragm numbers representing not merely the scale of diaphragms but the speed of plate, also a scale of time to represent not merely the actinometer time but the time of exposure required for each diaphragm.
3. In an exposure meter, the arrangement of actinometer with revolvable sensitive discs, substantially as described.
4. The forms of exposure meter substantially as herein described, namely, the slide rule form with scales as described, one of them sliding, and the box form with two contiguous annular discs carrying scales, one on the lid or glass and the other on the body of the box, and an actinometer combined therewith.
5. An exposure meter in which the exposures required for any set of conditions are calculated without the intervention or use of stops, pointers, or similar devices as hitherto used, substantially as described.

Dated this 5th day of March 1894.

WM. P. THOMPSON & Co.,
Of Liverpool, Manchester, Nottingham, and London, Patent Agents.

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A.D. 1893. May 30. N° 10,617.
WYNNE'S Complete Specifications.
(1 SHEET)

[This Drawing is a reproduction of the Original on a reduced scale]

FIG. 1.

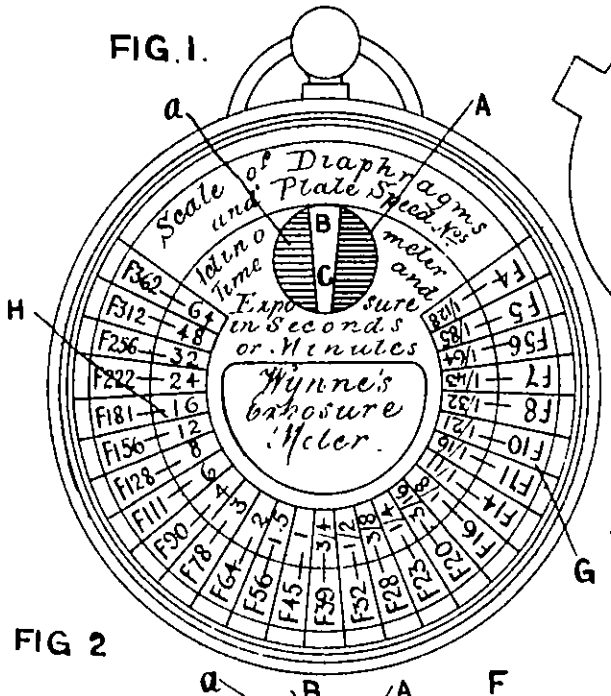


FIG 2.

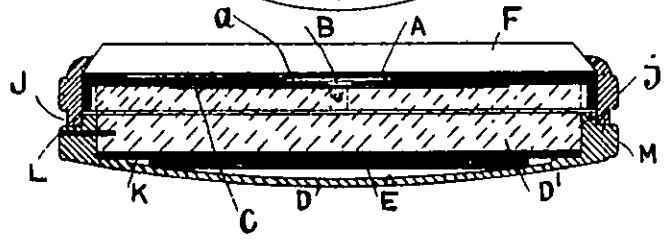
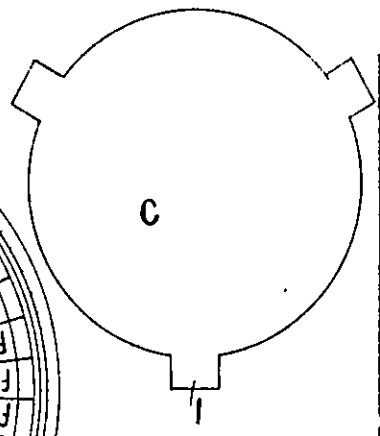


FIG 2a.



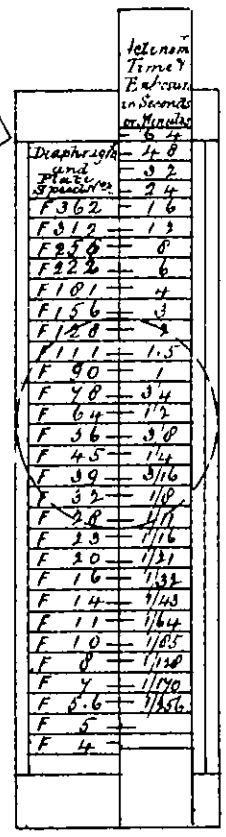


FIG 3

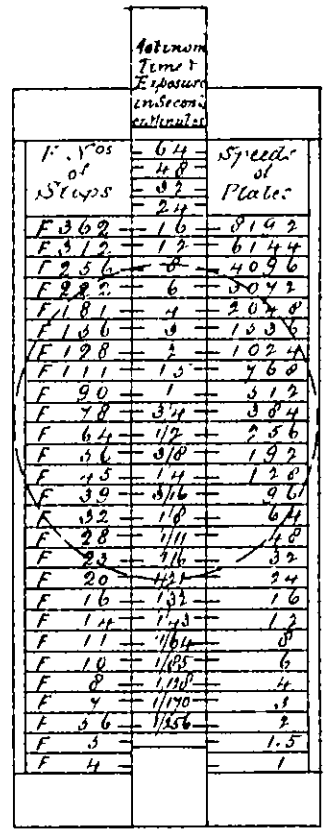


FIG 4

Malby & Sons, Photo-Litho

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